

CHAPTER 3 -- RESOURCE FUNCTIONS AND CONSIDERATIONS

The following chapter identifies the primary water resources functions to be protected by the proposed minimum flow and level (MFL) as well as the baseline resource conditions for assessing significant harm. Considerations for making this determination are set forth in Section 373.0421(1)(a) Florida Statutes (F.S.), which requires the water management districts to consider changes and structural alterations that have occurred to the water resources when setting a MFL. These considerations and exclusions are discussed below. **Chapter 3** also contains a discussion of resource protection issues, policies and procedures established to protect these resources.

WATER RESOURCE FUNCTIONS

The Loxahatchee River Watershed contains significant water resources that provide a wide range of functions and services to the regional system. These functions need to be clearly identified so that they can be adequately considered in order to protect the resource from significant harm. The primary water resource functions that were considered in the development of MFLs for the Loxahatchee River and estuary include:

- Fish and wildlife habitat, including threatened and endangered plants and animals
- Preservation of the river's "wild and scenic" values
- Providing drainage and flood protection for surrounding areas
- Water supply
- Recreation
- Navigation
- Preservation of historical and archeological values
- Water quality improvement

The Loxahatchee River and Estuary can be divided among a number of different geographic components as described in **Chapter 2**, including the Northwest Fork River and estuary, North Fork River and estuary, C-18 Canal (C-18), Southwest Fork and the central embayment. Based on the resources within these different components and the functions provided, SFWMD staff determined that the most critical need was to develop minimum flow criteria that would protect the Northwest Fork River from significant harm. This decision was reached because of the following: (a) the importance of the Northwest Fork as a Wild and Scenic River; (b) this resource is most threatened by historic, ongoing and potential reductions in flow and consequent changes in salinity; and (c) our initial analyses indicate that providing an acceptable minimum flow to the Northwest Fork River will also protect low-salinity, brackish water and marine resources in the downstream estuary.

Fish and Wildlife Habitat

A large portion of the Loxahatchee River watershed remains undeveloped and retains extensive native plant and animal communities. The river's tributaries and wetlands provide a regional wildlife corridor and habitat for important species, such as manatees, otters, alligators and many varieties of birds. Adequate freshwater flow and water levels are required to maintain these habitats for plants and animals. Maintenance of sufficient water depths and hydroperiods within the upstream watershed, and providing sufficient flows to the river are needed to protect existing plant and animal communities. The upstream freshwater portion of the river provides important habitat for freshwater (riverine) species of fish that are important to both recreational fishing interests and wading birds. Freshwater species include largemouth bass, bluegill, shellcracker, redbreast, warmouth, bowfin, channel catfish and many species of minnows. The freshwater swamp community contains a number of species of trees and shrubs that provide important specialized habitats and food (e.g. fruits) to birds, especially migratory and endangered species and other wildlife. These natural systems also provide treatment capacity to ensure that high quality water flows into the river and estuary.

The downstream estuary provides habitat for juvenile and adult estuarine species, such as snook, mangrove snapper as well as juvenile organisms that populate offshore reef communities. The Loxahatchee Estuary is also habitat for several endangered and threatened species including sea turtles, manatees and Johnson's seagrass (*Halophila johnsonii*). The U.S. Fish and Wildlife Service (USFWS) have designated the entire Loxahatchee River as critical habitat for West Indian manatee (FDEP and SFWMD, 2000). The maintenance of viable estuarine ecosystems requires a proper balance of freshwater inflow -- sufficient freshwater flow to provide brackish conditions at appropriate locations and time periods, and avoidance of high volume freshwater flows that may destroy or damage sensitive plants and animals.

Preservation of the River's Wild and Scenic Values

Based on its natural scenic qualities, diverse native plant and wildlife communities, and in order to preserve the natural landscape, the Northwest Fork of the Loxahatchee River was designated as Florida's first federally designated Wild and Scenic River in 1985. The upstream freshwater portion of the river is characterized by its extensive and diverse floodplain swamp and bald cypress community, which represents an important component of the regional ecosystem. These habitats include cypress and mixed hardwood swamp, freshwater marsh, wet prairie, slough, river, stream, pine flatwoods, sand pine scrub, oak scrub and hardwood hammock. The floodplain swamp community is both a unique and important habitat and represents one of the last remaining areas of this type in South Florida (McPherson and Sabanskas, 1980; United States Department of Interior, National Park Service, 1982).

The floodplain swamp supports a complex and diverse community structure comprised of low understory groundcovers and shrubs, medium height sub-canopy shrubs and hardwoods, and high canopy hardwoods, palms and bald cypress. The high canopy provides important habitat for a number of protected epiphytic plants, such as ferns, bromeliads and orchids (United States Department of Interior, National Park Service, 1982). The area also supports a diverse population of animals, including many that utilize surrounding upland and estuarine habitats. Invertebrates

(e.g. leeches, worms, juvenile and adult insects, crustaceans and mollusks), amphibians, fish and reptiles inhabit the inundated and exposed benthic areas of the swamp community. Understory vegetation provides refuge and food for a variety of small to large mammals, reptiles and insects. Tree trunks provide nesting cavities for birds and small to medium-sized mammals. In addition, the swamp forest canopy is an important habitat for birds, offering food (e.g. fruits, berries), refuge, roosting and nesting sites (Ewel, 1990b).

A total of 267 animal species have been observed in and along the river and estuary (FDEP and SFWMD, 2000). The cypress river swamp community supports a number of species that have been identified as endangered, threatened or species of special concern by the Florida Fish and Wildlife Conservation Commission (FWC), or listed as threatened or endangered by the USFWS (**Tables 10 and 11**, Chapter 2).

The long-term decline in the extent and health of the freshwater floodplain swamp community along the upstream portion of the Northwest Fork appears to be linked to hydrologic alterations of the river and its watershed, as well as past dredging activities in the estuary and Jupiter inlet. Combined, these two factors have resulted in reduced freshwater flows to the river, lowering of the ground water table and increased saltwater intrusion of the floodplain swamp community during dry periods. Sufficient freshwater flows are required during the dry season to protect the existing cypress community from further degradation and loss of natural function.

Drainage and Flood Protection

The Loxahatchee watershed and its rivers, canals and wetlands comprise an area of more than 200 square miles. Water levels in the rivers and canal systems are managed to provide for drainage of land and storage of water during the wet season and adequate conveyance capacity to protect lives and property in surrounding upland residential areas from flood damage during severe storm events. The amount of water that can be stored in the basin is limited due to the lack of sufficient storage capacity. For this reason, water must be discharged to tide in order to provide flood protection within the basin. Lack of regional storage can act as a constraint on the District's ability to fully meet the proposed MFL until increased storage capacity becomes available as a result of water supply development and restoration projects

The primary flood control facility for the Loxahatchee River Watershed is water control structure 46 (S-46). Structure 46 is a reinforced concrete, gated spillway located on the C-18 with discharge controlled by three stem operated, vertical lift gates. Structure 46 also supports water level upstream and downstream remote digital recorders, a gate position recorder and a rain gauge remote digital recorder. Design characteristics of S-46 are shown in **Table 13**.

Table 13. C-18 Flood Discharge Characteristics

Parameter	Design	Standard Project Flood
Discharge rate	3,420 cfs	3,420 cfs
Standard Project Flood	50% SPF	100% SPF
Headwater Elevation	12.8 ft NGVD	16.4 ft. NGVD
Tailwater Elevation	2.2 ft	2.2 ft
Type Discharge	Uncontrolled free	Controlled free

The gates are automatically controlled so that the operating system opens or closes the gates in accordance with the operational criteria discussed below. Structure 46 is located on Canal 18, about 0.5 mile east of the Florida Turnpike/Interstate 95 (I-95) and maintains optimum upstream water control stages in Canal 18. The structure is designed to pass 50 percent of the Standard Project Flood without exceeding the upstream flood design stage (**Table 13**); restrict downstream flood stages and channel velocities to non-damaging levels; and prevents saline intrusion of local ground water. Structure 46 is operated to maintain an optimum headwater elevation of 14.8 feet, when sufficient water is available to maintain this level, through automatic operation of the gates. The automatic controls on the gates function as follows:

- When the headwater elevation rises to 15.0 feet, the gates will open at a speed of 0.4 inches per minute.
- When the headwater elevation rises or falls to 14.8 feet, the gates will become stationary.
- When the headwater elevation falls to 14.5 feet, the gates will close at 0.4 inches per minute.
- During major storm events, the gates are operated manually to lower and maintain a headwater stage of 12.8 feet. A major storm event is defined as any event which causes a tailwater stage at the C-18 Weir to rise above 17.6 feet.

During large eastern basin storm events, the gates are operated manually to lower and maintain an S-46 headwater stage of between 13.0 and 14.0 feet. A large eastern basin storm event is defined as one that prevents adequate gravity drainage of the agricultural area at the junction of C-18 and the Turnpike. This operation will be maintained for 24 hours (or longer if conditions warrant).

Water Supply

The hydrology of the Loxahatchee watershed strongly influences the source and impacts of consumptive use. The orientation of the watershed is shown on **Figure 14**. The watershed is not a true watershed in terms of drainage and ground water flows but is an aggregation of several subbasins as defined by FDEP (1998). Drainage features within the watershed have been highly altered as discussed in earlier portions of this report. As a result, much of the water use in the watershed does not hydrologically influence flows in the Loxahatchee River, as discussed below.

The availability of fresh ground water is limited by the relatively low yielding nature of the shallow aquifer coupled with the presence of saline water to the east and numerous isolated wetlands to the west. The aquifer is inter-layered with low permeable fine sand, silt and hardpan beds that impede the vertical flow of water. The best production zones occur generally between 80 and 150 feet below land surface. Water produced by a well is derived from ground water stored in the interconnected pore spaces of the sediments that comprise the aquifer. Individual wells drilled into the Surficial aquifer in the watershed can produce about 150 to 300 gallons per minute. Larger wells produce more water. In localized areas, especially where the Biscayne Aquifer extends into this area along the Florida Turnpike, production rates may be much higher. The area of influence of a well is dependent primarily on the permeability of the aquifer, the

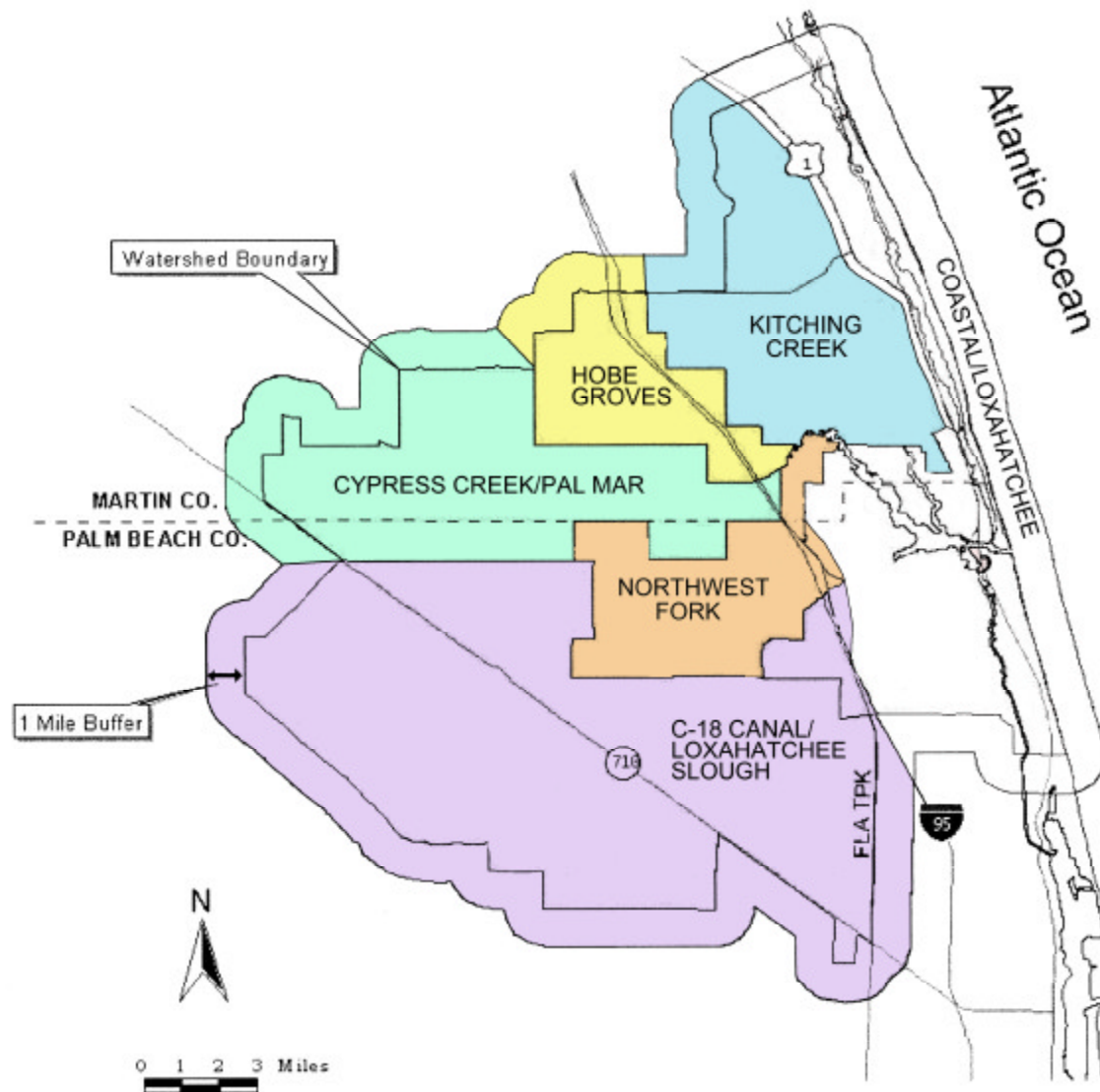


Figure 14. Loxahatchee watershed boundary (based on FDEP 1998) showing locations of sub-basins and 1 mile buffer added to the perimeter.

sustained rate of withdrawal, the storage of the aquifer (the volume of water produced from a unit volume of aquifer when the pressure is reduced by one unit), and the degree to which low permeability sediments (clay and silts) restrict the vertical recharge of ground water or surface water into the well. The area of influence of most domestic production wells within the watershed is generally less than 2,000 feet (an area of about 80 acres), depending on the volume of water pumped. The cone of depression resulting from pumpage may be small in aerial extent but becomes rather steep near the wellhead. Land uses in the basin include about 20,000 acres of agriculture (11% of the basin), 32,000 acres (18%) urban and industrial, 120,000 acres (67%) water and conservation and 8,000 acres recreational and industrial. Total water use in the basin is estimated at about 100 million gallons per day (mgd), of which, agriculture accounts for an estimated 18 percent, public water supply is 68 percent, and golf courses and industrial uses

account for about 14 percent. Due to the number of permits already issued and the need to protect the river and wetlands, very little allocable water remains from the surficial aquifer within the watershed.

The general locations of ground water contours during the dry season (April 1984) are shown on **Figure 15**. Ground water flow occurs perpendicular to the contour lines, from areas of high water levels toward areas with lower water levels. This figure was generated using ground water monitor data collected from regional (U. S. Geological Survey) and local monitor wells (water use monitor wells). While the ground water surface changes during the year based on rainfall and pumpage, the general west to east flow direction shown occurs throughout the year.

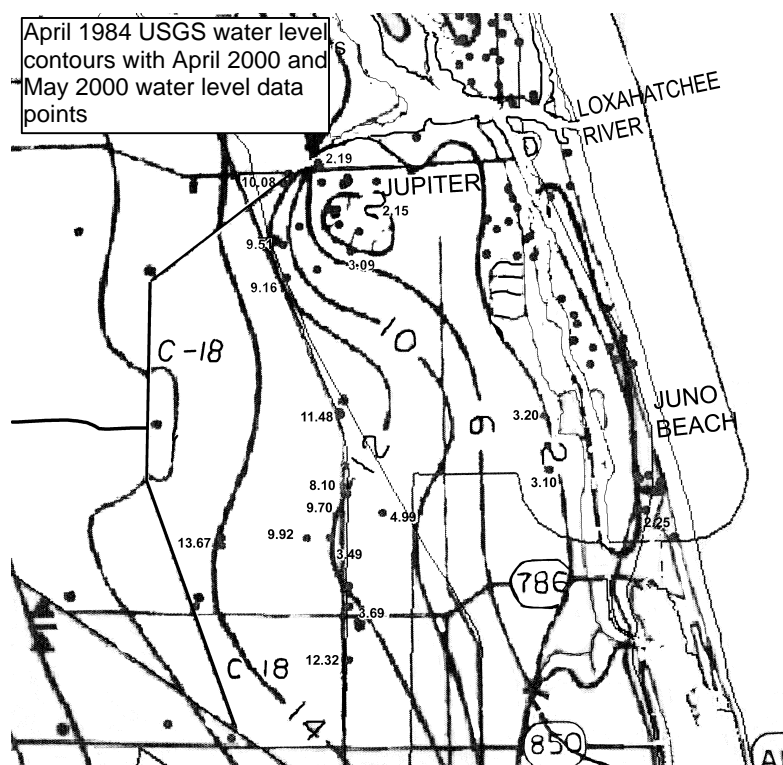


Figure 15. Ground water contours (numbers and lines) in the Loxahatchee watershed (April 1984) with water levels recorded in feet at monitoring wells (dots) during April and May 2000. The direction of ground water flow is perpendicular to the contour lines, from areas of high water levels to areas of low water levels.

As expected near the coast, the predominant direction of ground water flow is toward the Atlantic Ocean. In other areas, the flow is generally toward the east, with localized flow occurring towards the canals and large capacity wellfields. It should be noted that construction of the C-18, which is controlled at an elevation of about 14 feet, significantly changed ground water and surface water stages and flows in the surrounding watershed.

In this watershed, most of the permitted wells occur far enough away from the Loxahatchee River and C-18 that they do not significantly influence the ground water flow patterns to these surface water features. One notable exception is in the vicinity of the Seacoast Hood Road Wellfield where the water table contours suggest a potential influence beneath a

portion of the C-18 upstream of G-92 during dry conditions. Ground water uses with areas of influence that do not extend beneath C-18 or the river, and any withdrawals from the Coastal/Loxahatchee Sub-basin (non shaded portion of the watershed in **Figure 14**) were not considered in this analysis.

Due to advances in demineralization technology, and the limited availability of water from the Surficial Aquifer System, the alternative source of the upper portions of the Floridan Aquifer System (FAS) is currently used by both the Town of Jupiter and the Village of Tequesta. These wells have screen intervals located at depths greater than approximately 800 feet and yield brackish water. Elsewhere in northern Palm Beach County, the FAS is also being treated for use as a source for golf course irrigation. The additional capital and operational, maintenance, rehabilitation, repair and replacement required for desalination and the cost associated with disposal of the mineralized concentrate have limited the use of this alternative source.

Surface water from isolated lakes is used to meet small demands or is used in conjunction with ground water for irrigation. Most of the irrigation permits in the watershed that have a permitted surface water source also have a ground water allocation. These permits are established so that ground water, which is naturally high in iron and low in dissolved oxygen, can be aerated in a lake prior to use. Since the use of ground water to maintain lake levels for aesthetic purposes alone is not permissible, permits with both surface and ground water have special conditions that limit the amount of ground water withdrawn to not exceed the volume pumped from lakes for irrigation. Use of water from C-18 and the Loxahatchee River is also limited by environmental constraints and uncertainty in water supply availability during drought.

When a surface water body occurs within the area of influence of a well, the well may induce seepage out of the surface water body. This amount of seepage, if any, is influenced by the following factors:

- The depth of the surface water body compared with the depth of the well.
- The vertical permeability of the earth materials between the bottom of the surface water body and the well.
- The difference in water level elevations between the surface water body and the ground water table.
- The permeability of the sediments at the bottom and sides of the surface water body.

In the Loxahatchee watershed, the canals and river generally drain ground water. This means that the surface water levels are lower than the adjacent ground water table. In order for a well to cause seepage from the surface water body (an indirect withdrawal), the drawdown from the well would have to be large enough to produce a lower ground water level than the water elevation in the surface water body. These conditions rarely occur within the watershed.

Even though lowering of water levels may not be sufficient to result in a net flow of water away from the surface water body, it may cause a reduction in the amount of surface water or ground water that would otherwise have flowed into the water body.

As discussed elsewhere in this report, flows in the Loxahatchee River have been highly altered due to drainage -- specifically, construction of the C-18 and drainage of the Loxahatchee Slough. As a result of drainage, the flows in the river are "flashy," meaning that the flows increase very quickly after a storm event and decrease very rapidly after the drainage is achieved. In predevelopment times, the wetlands became flooded, the water was stored, and would gradually discharge into the river by overland flow and/or ground water seepage as the dry season progressed. Under these conditions, flow rates during storms were not as high and persisted for longer periods of time.

Today, there is not sufficient storage to mimic these conditions. However, beginning in the late 1980s, the district began to operate G-92 structure in a manner that attempted to maximize the time that flows would exceed 50 cubic feet per second (cfs). Under these conditions, a direct connection is maintained between the upper basin and the "wild and scenic river." During periods when dry conditions persist, however, there is not enough water in the C-18 to deliver to the Loxahatchee River, the C-18 is no longer connected to the river and consumptive use impacts upstream of G-92 may impact flows to the river. Such impacts occur today because the amount of storage available in the eastern portion of the C-18 has been reduced to about 200 acre-feet (water levels between 12.5 and 14.5 feet), which is much smaller than the several thousand acre-feet of storage that existed before construction of the C-18 (SFWMD, 2002)

With the development of additional storage up stream, as detailed in the MFL recovery plan in **Chapter 6**, additional water will be available for delivery to the Loxahatchee River via C-18 during dry conditions. As a result, the impacts of water use in areas adjacent to the C-18 should be offset by sufficient supplemental deliveries from these proposed storage facilities.

Recreation

The many wetlands and surface waters in the watershed provide extensive opportunities for recreational fishing, boating, hunting and waterskiing. The estuary includes DuBois and Jupiter Inlet parks, which are used extensively for recreational boating, fishing and swimming and family picnics. Many of these uses depend on providing adequate water levels, flow and water quality to support healthy plant and animal communities along the Northwest Fork and downstream estuary as well as safe public contact.

Significant recreational opportunities are provided in Jonathan Dickinson State Park (JDSP), including camping, hiking, canoeing, kayaking, boating and wildlife observation. The Trapper Nelson Interpretative Site has educational, historical and archaeological features. The Loxahatchee Queen riverboat offers daily cruises for sightseeing. A Girl Scout Camp and a Boy Scout Camp are located adjacent to the Park. JDSP encompasses 11,480 acres and attracts 169,768 visitors annually (1999-00), largely because of the Loxahatchee River and recreation that depends on it. According to research conducted by FSP, the total direct economic impact of JDSP on the local community is \$5,101,443 annually. Deterioration of the ecology and aesthetics of the river are serious concerns that affect tourists and the local community. The FDEP has a statutory responsibility under Ch 258.037 F.S., "to promote the state park system for

the use, enjoyment, and benefit of the people of Florida and visitors; to acquire typical portions of the original domain of the state which will be accessible to all of the people, and of such character as to emblemize the state's natural values; conserve these natural values for all time; administer the development, use and maintenance of these lands and render such public service in so doing, in such a manner as to enable the people of Florida and visitors to enjoy these values without depleting them..."

Maintenance of a minimum flow and level is needed to provide for adequate access and enjoyable use of the resource. MFLs are also necessary to protect the water resources and vegetation communities that provide the landscape and wildlife that support these recreational activities. Impacts on recreational use of the river occur when low flows and low water levels impair the ability of the public to access the "wild and scenic" portion of the river by boat.

Navigation

The estuarine portion of the system supports navigation along the Intracoastal Waterway (ICW), maintained by the U.S. Army Corps of Engineers (USACE) and the Florida Inland Navigational District (FIND). Jupiter Inlet District maintains the Jupiter Inlet with a channel depth of -13 feet National Geodetic Vertical Datum (NGVD). Construction and maintenance of deep channels for navigational use and connection to the ocean at the inlet are in part, responsible for the increased saltwater intrusion that has occurred during the past century.

Discussions with canoe rental concessionaires that use the Northwest Fork on a regular basis indicate that when flows over the Lainhart Dam are less than 35 cfs, navigation and recreational use of the Northwest Fork becomes impaired. Access to the river by recreational boaters, fishermen, canoeists and kayakers becomes limited and at times, is restricted. Persons who have used the river during these low flow periods report that many fallen trees, littoral areas and shoals are exposed or contain only a few inches of water at low tide, thereby creating conditions that limit navigation and recreational use of the resource. Such low water conditions must occur periodically to protect cypress and other communities that require occasional drying of the substrate for seed germination to occur.

Historical and Archeological Values

The upper segment of the Northwest Fork of the Loxahatchee River is noted for its rich historical significance. The area contains numerous sites that were used by pre-historic Indians (e.g. middens). The oldest of these sites date back to the Late Archaic period, from 3000 to 750 BC. Remains of two battles that occurred between Europeans and Indians in pre-settlement times have been located along the river corridor (the "Loxahatchee Battlefield"). A more recent historical site is the Trapper Nelson zoo and homestead, located within JDSP. Segments of the river near these sites have been federally designated as "Wild", "Scenic" or "Recreational". The "wild and scenic" segments of the river have been protected in order to preserve the biological (i.e., bald cypress community), cultural and scenic values for future generations. Establishment of MFLs for the Northwest Fork will aide in providing the needed freshwater flows required to maintain these historical and archeological sites in a condition similar to pre-settlement times.

Water Quality Improvement

In addition to its importance as fish and wildlife habitat, the Northwest Fork provides an important source of clean freshwater to the estuary. The District has the responsibility to ensure that the establishment of MFLs does not hinder the ability to meet applicable state and/or federal water quality standards. The Loxahatchee-Lake Worth Creek Aquatic Preserve has Class II and III waters. Outstanding Florida Waters occur within JDSP and along the “wild and scenic” segments of the river. The C-18 is a Class I water body but is not directly utilized as a source of public water supply. These classifications are summarized in **Table 14**.

Table 14. Water Quality Classification of Waters in the Loxahatchee River

CLASS	GENERAL DESCRIPTIVE USE	APPLICATION WITHIN THE LOXAHATCHEE RIVER
<i>I</i>	Potable Water Supply	Freshwater portion of SFWMD Canal C-18; upstream of Control Structure S-46 is indirectly used for public water supply
<i>II</i>	Shellfish Harvesting and Propagation	Estuarine portions of the North, Northwest and South Forks, upstream from FEC Railroad Bridge and in the aquatic preserves are designated for this use.
<i>III</i>	Recreation and Propagation of Fish and Wildlife	Loxahatchee Slough and the SFRWCD Canal C-14; Fresh-water portions of the North and Northwest Forks of the Loxahatchee River; marine and coastal waters downstream from the FEC Railroad Bridge to the Jupiter Inlet,

Source: SFWMD 2000a

Although water quality in this system generally meets applicable standards, problems occasionally occur in the river and estuary with respect to dissolved oxygen levels, coliform bacteria and total nitrogen (FDEP, 1996; 2000).

The primary source of water to the river is the G-92 structure, which drains the Loxahatchee Slough, and has water of good quality. The relatively undeveloped basins along the Northwest Fork and Kitching Creek provide water that has little, if any, human-contributed sources of pollution. Water discharged from some basins along the river contains suspended solids, nutrients, pesticides and other contaminants that impact the river and downstream estuary (FDEP 1998). The floodplain swamp communities that fringe the upstream portion of Northwest Fork potentially provide a significant water quality improvement function (Ewel and Odum 1984; Dierberg and Brezonik 1984; Zahina et al. 2001b). The MFL seeks to minimize significant harm to this community, thus protecting this water quality function.

RESOURCE PROTECTION ISSUES AND CONCERNS

The Northwest Fork contains one of the last examples of a pristine subtropical riverine cypress swamp in south Florida. Protection of this resource requires reducing or reversing the current trend of saltwater intrusion and mangrove invasion within the upstream freshwater portion of the river by maintaining minimum baseline freshwater flows to the Northwest Fork. Maintenance of freshwater habitats in the upper reaches of the river is also desirable to protect existing populations and distribution of wildlife (e.g., fishes, alligators, turtles and otters) that require freshwater habitat. Reduction of sediment loading from tributaries is required to protect benthic communities in the river and estuary.

The Loxahatchee watershed is comprised of both surface and ground water resources that are closely linked together. The Surficial Aquifer System (SAS) receives recharge from the land surface (uplands and wetlands within the watershed). The surficial aquifer also provides an important source of freshwater base flow that maintains upstream wetlands and provides freshwater discharge to the river and estuary. Because of this relationship, withdrawal of water from the SAS during dry periods has the potential to affect water levels in surrounding lakes and wetlands and possibly reduce base flows to rivers and streams. This could affect salinity conditions within the river and estuary, as well as result in further saltwater intrusion of the aquifer. At present, there is very little hydrologic information regarding the roles that ground water discharge and groundwater withdrawals play in providing base flows to the river or estuary.

Much concern has been expressed in public meetings and correspondence that consumptive use withdrawals within the watershed have significant adverse effects on flows in the Northwest Fork and the migration of saltwater upstream. Analysis of existing data, however, suggests that the effects of consumptive uses on the ability to provide flow to the river during dry periods are not very large (i.e., less than 5 cfs) and are much less than the effects of canal construction and the drainage of lands for agricultural and residential development. See **Appendix I** and **Appendix O** for further details. The effects of reduced river flow on migration of saltwater upstream are, in turn, less than the effects of stabilization of the Jupiter Inlet and removal of shoals and sandbars in the Loxahatchee River and Estuary. Monitoring of consumptive use is carried out by the SFWMD during drought periods to ensure that allocations are not exceeded and to determine whether withdrawals of water for human use are decreasing the amount of water available for discharge to the river. The possibility remains that alternative sources may need to be developed if withdrawals in the future are determined to have significant adverse effects on river flow.

Provisions need to be made to ensure that minimum flows to the river occur in order to prevent saltwater intrusion and associated problems. Several options are being investigated as part of the MFL Recovery and Prevention Plan (see **Chapter 6** for details) or implemented as part of the regional water supply planning process to correct some of the problems that have occurred due to structural changes in the watershed, and provide additional water for the river, as follows:

- Improve hydrologic connections between the historic Loxahatchee Slough (i.e., West Palm Beach Catchment Area) and the Northwest Fork.
- Improve management of water levels in Loxahatchee Slough.
- Construct additional pumps, structures and conveyance capacity to allow more water to enter and be stored within the Loxahatchee Slough.
- Construct connections between the C-18 and C-17 basins and between Kitching Creek (Northwest Fork) and South Fork of the St. Lucie River as part of the CERP planning process.
- Conduct a feasibility study to assess the benefits or impacts of the construction of a navigable submerged dam, low or collapsible weir,

- or artificial shoal to obstruct inland movement of the saltwater wedge during dry periods.

CONSIDERATIONS AND EXCLUSIONS

Once the functions of the water resource and the features of the water resource that need to be protected by a specific minimum flow or level have been identified, the baseline resource conditions for assessing significant harm must be determined. The basis for making this determination is set forth in Section 373.0421(1)(a), F.S., which requires the water management districts to consider changes and structural alterations that have occurred to a water resource when setting a MFL. Section 373.0421(1)(b), F.S., provides exclusions from the MFL requirement by recognition that certain water bodies no longer serve their historical function and that recovery of these water bodies to historical conditions may not be feasible.

Considerations

The Loxahatchee River system has a variety of features and functions that affect, or are affected by, the need to establish MFLs as follows:

- Natural Systems
- Hydrology
- Water Supply
- Flood Protection
- Water Quality
- Navigation and Recreation

The section below provides a summary of how each of these elements was considered in the Loxahatchee River system.

Natural Systems

- Natural systems in the Loxahatchee River system have been significantly altered due to human activities during the past century.
- In spite of these changes, many of the original natural features remain in good condition. The Loxahatchee River and Estuary contain significant natural features, including threatened and endangered species and their associated habitats.
- Declaration of the estuarine area by the state as a state aquatic preserve and part of the riverine area by state and federal authorities as a Wild and Scenic River, indicates that necessary efforts should be undertaken to protect or enhance remaining natural features.

Hydrology

Hydrologic changes, which have occurred in the Loxahatchee River and Estuary due to navigation, drainage and flood control activities, have significantly altered the volume, timing

and distribution of freshwater flow. Providing sufficient flows to maintain appropriate hydrologic conditions within the basin is the key element needed to maintain the integrity and viability of associated wetland, riverine and estuarine ecosystems. Five primary threats to maintaining the integrity of this system are linked to water flows and levels as follows:

- Seawater (saltwater) access to the river has been increased by the permanent opening of the Jupiter Inlet and by dredging of the ICW and river channels.
- Flow patterns in the river itself have been altered due to construction of the inlet and associated navigational channels and the removal of natural shoals from the estuary.
- Water levels in wetland systems that provide water to Loxahatchee Slough and base flow to the river have been lowered to provide flood protection to adjacent lands, and subjected to unnatural hydroperiods to meet drainage and flood protection needs of surrounding areas.
- Lowering of water levels throughout the watershed, to provide drainage and flood protection, has resulted in overall loss of storage within the basin and thus reduced the total volume of water that is available to the river during the year.
- Withdrawals of surface and ground waters for urban and agricultural use have contributed to alteration of the timing and volume of freshwater storage in wetlands and discharge to the river and estuary.

Water Supply

Two primary sources of water are used for water supply and agricultural irrigation within this watershed -- withdrawals from the surficial aquifer; and withdrawal from the Floridan aquifer.

- Withdrawals from the Surficial aquifer system have the potential to influence water levels in adjacent wetland systems and affect ground water discharge to the river and estuary.
- Withdrawals from the Floridan aquifer system do not influence water flows to the river or estuary directly but create the need for disposal of the reverse osmosis concentrate and therefore require a permit from the FDEP.

Section 373.042 (a) F.S. prohibits allowing significant harm to be caused by existing or future water supply withdrawals. Once the MFL is established, the need to meet existing and future reasonable-beneficial water supply requirements must be factored into the recovery and prevention strategy, as explained in Section Ch. 373.0421(b) F.S.

Flood Protection

- The C-18 is a component of the regional primary drainage system and provides flood protection for an area of 200 square miles. Numerous secondary and tertiary drainage features contribute flow to C-18.
- Construction of the C-18 within the historic Loxahatchee Slough to meet drainage and flood control needs has resulted in a significant lowering of water levels in adjacent

wetlands, loss of regional storage and overall reduction in base flow to the Loxahatchee River and Estuary during dry periods.

- The C-18 has altered regional hydrology significantly by diverting drainage and runoff into the South Fork of the Loxahatchee Estuary. Much of this area, under natural conditions, would have provided sustained, dry-season base flow of freshwater to the “wild and scenic” portion of the Northwest Fork of the Loxahatchee River.
- During wet periods the network of drainage canals and structures results in discharge of excessive volumes of poor quality water, primarily to the estuary, that impact saline and brackish water communities in the Aquatic Preserves.
- The Jupiter Farms area (SIRWCD) covers approximately 10,315 acres and drains primarily to the Northwest Fork of the Loxahatchee River.

Water Quality

- Water quality data have been compiled and analyzed by the Florida DEP to determine current status and trends in this system. Results of this analysis indicate that water quality in this system is generally adequate to meet the designated uses, which include the following:
 - Public water supply (Class I) use for the C-18 upstream of S-46.
 - Fish and wildlife habitat/natural systems (Class III) use in Loxahatchee Slough and C-14 Canal (C-14), the Northwest Fork and the North Fork; marine and coastal waters.
 - Shellfish harvesting (Class II) use in estuarine waters and Aquatic Preserves.
- A few exceptions have been noted where these standards are not met periodically at some locations as follows:
 - Low levels of dissolved oxygen occur periodically in some parts of the system.
 - Total coliform concentrations exceed safe standards in the Northwest Fork near JDSP, in the North Fork near the Girl Scout Camp and at Dubois Park near the Jupiter Inlet.
 - Rapid changes in salinity and increased turbidity are associated with high volume releases of freshwater from C-18 during and after severe storm events.
 - Runoff from residential and agricultural lands, especially during storm events, periodically contain high concentrations of suspended solids that cause siltation and shoaling in the river channel.
 - Waters discharged from agricultural lands occasionally contain measurable quantities of pesticides and low concentrations of dissolved oxygen that may cause fish mortality.
- Water quality issues in the river will primarily be addressed through the identification impaired water bodies and development of Total Maximum Daily Load (TMDL) criteria for segments of the watershed that have significant problems.

Navigation and Recreation

- The Loxahatchee River and Estuary serve important functions as a regional recreational resource and tourist destination. These waters are used extensively and intensively for boating, canoeing, fishing, swimming, waterskiing and observing nature. Related commercial uses are centered around boat services, sightseeing cruises and fishing.
- Construction of the Intracoastal waterway resulted in the deepening and widening of channels, and increased water exchange between freshwater environments of Loxahatchee River and the brackish water systems in the southern end of the Indian River Lagoon and Lake Worth Creek.
- Permanent stabilization of the Jupiter Inlet altered the balance of freshwater-saltwater exchange within this system, resulting in increased flow of saltwater upstream in the Northwest Fork and associated decline of freshwater vegetation along the riverbanks.
- Landward movement of saltwater has been further enhanced not only by drainage activities in the basin (see above) but also by removal of natural shoals, sandbars and oyster bars to reduce the risk to navigation and provide access upstream by larger boats.

Exclusions

As described in **Chapter 1**, Section 373.0421(1)(b), F.S., recognizes that in certain cases, it may not be practical or feasible to restore particular water bodies to historical conditions. District staff suggest that exclusions do not apply to the establishment of minimum levels for Loxahatchee River system. The remaining exclusions in subsections 373.0421(1)(b)2 through 3, F.S. pertain to water bodies less than 25 acres in size or constructed water bodies and as such, do not apply to the Loxahatchee River and Estuary.

The Loxahatchee River and Estuary have been greatly altered by development and associated needs for water supply and flood protection, to the extent that full recovery of water levels and flows in the river headwaters, the river itself and the estuary may be technically and economically infeasible. However, the need to protect and enhance the remaining natural features in this system has been clearly identified. The Loxahatchee River and Estuary and their associated watershed include a federal and state-designated Wild and Scenic River, State Aquatic Preserves, state and local parks and have been designated as Outstanding Florida Waters. The considerations in Section 373.0421(1)(a) F.S. seem to adequately address the changes and alterations in water resource functions applicable to these areas. As a result, there is no apparent basis to invoke the exclusion in subsection (1)(b)1.

A baseline condition for the protected resource functions of the Loxahatchee River and Estuary has been identified, based on consideration of changes and structural alterations in the hydrologic system. This condition is the extent and health of the freshwater floodplain swamp community defined in this report. Evidence presented in this report indicates that the present (2001) location and condition of this community are not significantly different from their extent and condition in 1985, when the Wild and Scenic River designation occurred. The need to document the economic and technical feasibility of restoration of this system to some level of

ecological condition that existed prior to 1985 will be addressed through a cooperative study that is presently being developed by FDEP, SFWMD and other interests.

In summary, the SFWMD will establish a MFL for the river that is based on consideration of the effects of structural alterations to the water resource, as allowed pursuant to Section 373.042(1)(a). Section 373.042(a) F.S. prohibits allowing significant harm to be caused by existing or future water supply withdrawals. Once the MFL is established, the need to meet existing and future reasonable-beneficial water supply requirements must be factored into the recovery and prevention strategy.